Radiation Hardened Optoelectronics for Optical Interconnects

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The official link for this solicitation is:
http://www.acq.osd.mil/osbp/sbir/solicitations/sbir20152/index.shtml

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Description:
With the dominance of parallel processing, the rise integrated “system on chip” (SOC) architecture, and the continuing need to handle more data more quickly, traditional electronic interconnects are reaching their practical limits. Optical data transfer has already replaced electronic data transfer in long distance applications (km) and shorter distance high bandwidth applications (m-cm) due the combination of high bandwidth and low loss. Optical interconnects can also be very robust in extreme temperature and radiation environments making them well suited for satellite and unmanned vehicle applications. Optical data transfer over shorter (cm-mm) distances faces several significant technical and integration challenges. Some of these challenges are directly related to scaling: diffraction limitations, coupling efficiencies and cross talk, and fabricating efficient scaled emitters and detectors. Other challenges are related to material and wavelength challenges. Silicon, the semiconductor of choice for the electronic industry, has an indirect optical band gap making it an inefficient emitter or lasing material. Silicon, while a common detector material for visible wavelength, cannot be used as a detector for the common telecommunication wavelengths (1550 nm and 1330 nm). All silicon/silicon oxide optical interconnects would be ideal for integrating with conventional CMOS fabrication, however it is likely that techniques utilizing alternate semiconductors will be required at least in the near term. Current solutions include epitaxial germanium and wafer bonded III-V semiconductors for detectors and emitters. Hardening the optoelectronic components of optical interconnects to radiation effects (total ionizing dose, displacement damage, single events, color center formation, and optical loss) is necessary before they are incorporated in satellites or unmanned vehicles (unmanned aerial vehicles or robots) that are expected to operate in high

radiation environments. Electronics and optoelectronics in these systems are typically expected to be able retain functionality during gamma, neutron, and high energy ion exposures with lifetime total ionizing doses between 100kRad and 1MRad (silicon). Optical interconnects may also offer significant advantages in hardening systems against electromagnetic pulses and electromagnetic weapons by eliminating the antenna effects caused by cabling or long electrical interconnects. PHASE I: Demonstration and preliminary radiation effects testing (to a WMD relevant dose) of at least one scaled or near scaled active optical interconnect component (e.g. emitter, modulator, detector). Development of a plan for scaled (or near scaled) complete optical interconnect prototype. PHASE II: Development, fabrication, and preliminary radiation effects testing (to a WMD relevant dose) of a scaled or near scaled optical interconnect prototype with at least two active components and a coupled waveguide. Development of an approach for mitigating any observed radiation effects. PHASE III: Dual use applications: Suitably scaled and energy efficient optical interconnects could be utilized in commercial server, data centers, and high performance computers. Radiation resistant high reliability optical interconnects also have potential applications in commercial aviation, automobiles, and medical devices.